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State of the Art in Selective Breeding of Aquacultured Species

Bjarne Gjerde*

AKVAFORSK, Institute of Aquaculture Research, P.O. Box 5010, N-1432 Ås, Norway

Abstract

The first selective breeding programs for aquaculture species that also used sib information in the selection decisions were established in the early 1970s for Atlantic salmon and rainbow trout. Presently there are a total of about 60 such programs for about 20 different species in the world. However, still less than 5% of the world aquaculture production is from genetically improved stocks and most of these programs practice selection for a narrow breeding objective (e.g., growth only). An exception is Atlantic salmon for which close to 100% of the production is from improved stocks and selection is practiced for much broader breeding objectives including as many as 6-10 different traits (growth, sexual maturity, disease resistance, carcass quality, deformities) in some of the programs. A sustainable selective breeding program needs reliable genetic parameters and economic values for all traits of economic and strategies are important. In published literature there are few reliable estimates of genetic correlations between traits, and no objective study has been performed for economically important species on the derivation of economic values. Studies on the design of cost effective simple (mass selection) and advanced (use of sib information also) nucleus selective breeding programs for aquaculture species are few. More studies should be undertaken that take into account the high fecundity and reproductive characteristics of the species and should be performed at a predefined and acceptable rate of inbreeding. Important also are studies on the effects of new selection algorithms and mating design, new and emerging technologies like DNA-markers for both parental assignment and marker assisted selection, new technologies that can record more of the traits selected for on live breeding candidates, and procedures to obtain unbiased estimates of genetic changes, as well as studies on the long-term effects of a low but significant interaction between genotype and environment on important traits in a competitive market for genetic material. At the multiplier level, additional studies are needed on selection and mating strategies to fully capitalize both on the additive and non-additive genetic effects and how additional strategies like ploidy and sex manipulation may be used to further increase the productivity of the commercial fry. A socio-economic challenge is the need for some form of legal or biological protection measures to assure a fair share of the revenues from genetic improvement to investors and for further research and development of the breeding programs, while at the same time having access to genetic resources for further development of the programs.

* E-mail: bjarne.gjerde@akvaforsk.no